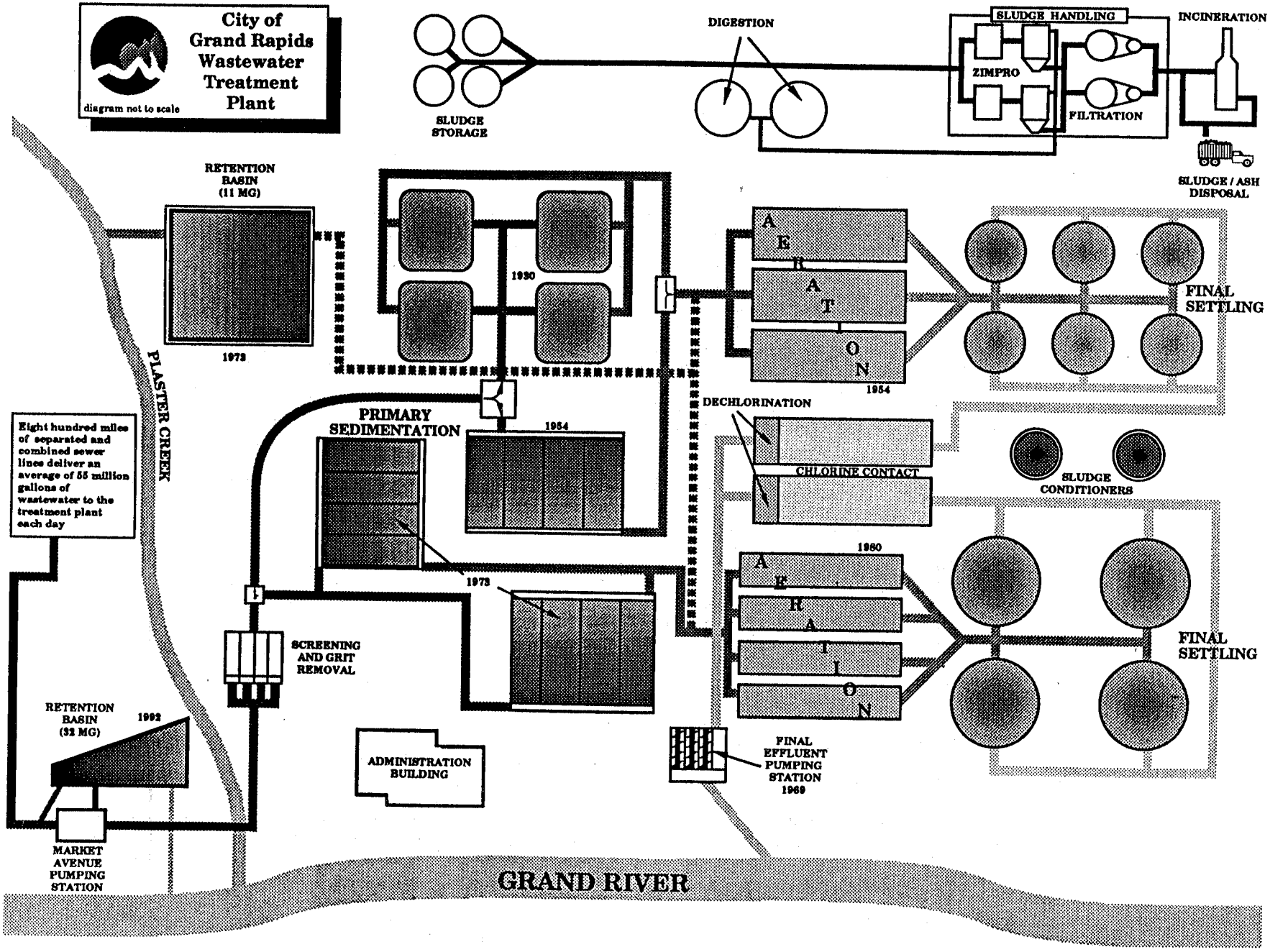

City of Grand Rapids Wastewater Treatment Plant
diagram not to scale
SLUDGE STORAGE
DIGESTION
SLUDGE HANDLING
ZIMPRO
FILTRATION
INCINERATION
SLUDGE / ASH DISPOSAL
RETENTION BASIN (11 MG)
1973
1930
AERATION
1954
FINAL SETTLING
PLASTER CREEK
Eight hundred miles of separated and combined sewer lines deliver an average of 55 million gallons of wastewater to the treatment plant each day
PRIMARY SEDIMENTATION
1954
1973
DECHLORINATION
CHLORINE CONTACT
SLUDGE CONDITIONERS
1980
AERATION
FINAL SETTLING
SCREENING AND GRIT REMOVAL
RETENTION BASIN (32 MG)
1992
ADMINISTRATION BUILDING
FINAL EFFLUENT PUMPING STATION
1969
MARKET AVENUE PUMPING STATION
GRAND RIVER

City of Grand Rapids Wastewater Treatment Plant Description

On a daily average 55 million gallons of wastewater, generated by the city of Grand Rapids and surrounding communities, is delivered to the treatment plant by approximately 800 miles of sewer line. Most of the wastewater requires pumping in order to reach the plant. Stations distributed throughout the collection network accomplish this task. The *Market Avenue Pumping Station*, located near the plant, is the final pump station and delivers the majority of the wastewater to the plant.

Administration Building: A *Process-control computer system*, housed in the administration building, provides comprehensive monitoring of the waste treatment process and handles many plant control functions. A large, well equipped *laboratory facility* provides necessary analysis enabling plant personnel to operate the process at maximum efficiency. Modern equipment includes an atomic absorption spectrophotometer for metal analysis, a gas chromatograph/mass spectrometer for organic analysis, and several computer controlled auto-chemistry systems. Wastewater is monitored daily, sometimes hourly, at each step of the treatment process in order to insure compliance with state and federal clean water requirements. Some toxins are monitored on a continuous basis.

Screening and Grit removal: *Bar Screens* - In order to protect mechanical equipment in the treatment plant, large debris and string material are removed from the wastewater by coarse bar screens. Substances mechanically removed in this process are placed in containers and periodically trucked to an approved landfill. *Grit Chambers* - Coarse, inorganic solids (e.g. sand, rocks, gravel, etc.) are allowed to settle in a recessed depression at the bottom of sewer lines, known as a grit chamber. Removal of this material reduces wear on operating mechanisms and limits build up of inert solids in the process tanks. Collected material is periodically transferred to approved landfills for disposal.

Primary Sedimentation: The separation of solids and liquids takes place in the primary settling tanks. About one hour is required for wastewater to flow through a primary tank. During this time, heavy solid waste material settles to the bottom of the primary tanks. The cleaner water flows on for further treatment. In the Grand Rapids system the removal of all solid material takes place in the primary system. The total removed amounts to approximately 50 thousand pounds per day. This material is periodically pumped to *Sludge Storage Tanks* and then into *Sludge Handling* facilities.

Secondary Treatment: *Aeration Tanks* - Micro-organisms occurring naturally in the wastewater are allowed to multiply in the aeration tanks in proportion to the amount of organic material that escapes primary settling. Air is continuously supplied to the tanks to satisfy the oxygen demands of the vigorously growing bacterial culture. This bacteria reduces most of the organic matter to carbon dioxide, nitrogen, and water. The aerated wastewater then flows on to *Final Settling Tanks*. There the solid material, termed *Activated Sludge*, settles to the bottom of the tanks. This solid material is rich in biological content and a portion is returned to the head end of the aeration tanks insuring the maintenance of the bacterial culture. The treated water, flowing from the surface of the tanks, continues on through the process.

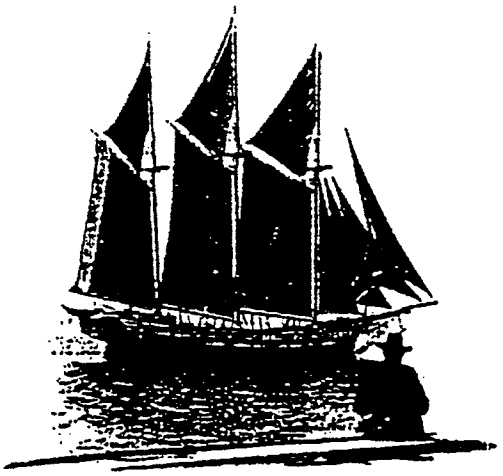
Chlorination: Chlorine, stored in railroad tank cars, is mixed with the treated wastewater in underground *Chlorine Contact Tanks*. This process disinfects the wastewater preventing bacteria from reaching the environment. However, chlorine is itself an environmental threat. Sulfur dioxide is used to eliminate excess chlorine in a process known as Dechlorination. The fully treated wastewater, now ready to be returned to the environment, is allowed to flow into the Grand River.

Final Effluent Pumping Station: Under normal conditions, treated wastewater flows by gravity into the Grand River. However, when the river is at a high stage due to spring snow melt or rainfall, a pumping station is required to transfer the final effluent into the receiving stream.

Sludge Handling: Solid material, remove in *Primary Sedimentation*, can be stored for up to 30 days in *Sludge Storage Tanks*. This material is pumped at a controlled rate into a thermal conditioning system. The solid material is heated to nearly 400°F under 400 PSI in a system known as *Zimpro*. This process destroys the water binding biological components in the solids thereby improving the removal of excess water. *Vacuum Filtration* is used to literally suck excess water from the solids. The resulting semi-solid, known as "filter cake", is either transported to approved landfill or sent to a *Multiple-hearth Incinerator*. Ash resulting from incineration is transported to landfill.

Retention Basins: Currently the city of Grand Rapids has two retention basins. One, located near the *Market Avenue Pumping Station*, limits the volume of untreated wastewater diverted to the Grand River during periods of heavy rainfall. The basin, capable of holding 32 million gallons of mixed wastewater and rainfall, stores excess water until the flow in the collection network drops. At that time the basin contents are pumped to the Wastewater Treatment Plant for full processing. A second basin, located on the grounds of the Wastewater Plant, is used for the temporary storage of excess primary effluent in order to maintain a uniform flow to secondary treatment. This condition is usually associated with excess flows caused by rainfall. The basin also provides temporary containment of hazardous wastes to avoid upsets to the treatment process. Both basins are equipped to provide disinfection in the event they are forced to overflow into a receiving stream.

Combined Sewer Overflow: Approximately 10% of the Grand Rapids wastewater collection system carries both sanitary sewage and storm water discharge. This is known as a *combined sewer system*. Normally, all water entering this portion of the collection system flows to the Wastewater Treatment Plant. However, during periods of heavy rainfall, the combined sewers are not capable of handling the excess water which must be diverted to the Grand River. This event is known as a combined sewer overflow or *CSO*. The recorded history of CSO's date back to 1930, the year Grand Rapids began treating sewage. During that initial decade, CSO volume approximated 7 billion gallons per year. By the 1960's the volume exceeded 10 billion gallons per year. However, plant expansion and improvements in the collection system during the 1970's reduced the average CSO volume to about one half billion gallons per year. The Market Avenue retention basin (discussed above), a planned separation of the combined sewers west of the Grand River, and further improvements in the collection system should eliminate the remaining CSO's.



Sailboat Regatta

1. FORM TEAMS IN EACH LAKE GROUP: EACH TEAM WILL CONSISTS OF 2 PEOPLE

2. EACH LAKE GROUP WILL BE ALLOWED TO QUALIFY 2 SAILBOATS: THEY WILL BE RACED IN COMPETITION ON THE FINAL DAY OF OUR "WATER-UNIT"

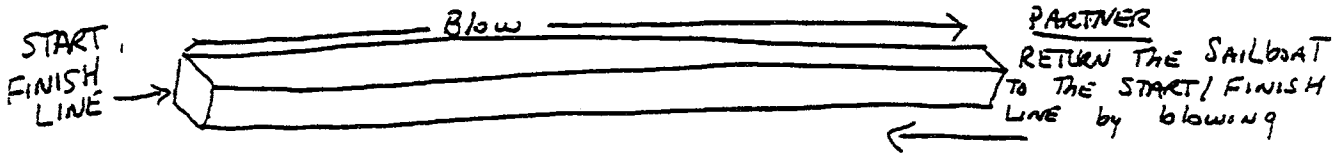
3. EQUIPMENT NEEDED:
   a. Family size bar of Ivory soap
   b. Skewers or straws for masts
   c. Laminated paper sails
   d. 2 - 10 foot lengths of eaves-through (with ends sealed to hold water)
   e. Paint (optional) - Testors spray paint works well

4. SCHEDULE TIME DURING THE "WATER-UNIT" FOR CARVING, DESIGNING AND QUALIFYING THE SOAP SAILBOATS

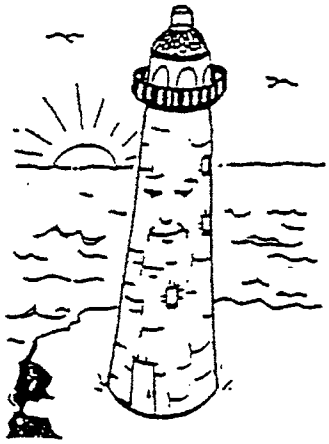
5. REQUIREMENTS ON SOAP BOATS
   a. Total length of the finished boat = maximum of 6 inches
   b. Total width of the finished boat = maximum of 3 inches
   c. Sail height 6 inches by 4 inches

6. THE CONTEST: YOU WILL NEED 2 - 10 FOOT LENGTHS OF EAVESTHROUGH; EACH ABOUT ONE HALF FULL OF WATER.

   A. THE OBJECTIVE IS TO BLOW YOUR SAILBOAT FROM THE START/FINISH LINE TO THE MID-POINT OF THE RACE (the other end of the through) WHERE YOUR PARTNER WILL BLOW THE BOAT BACK TO THE START/FINISH LINE.



   B. RUN A TOURNAMENT: THE WINNERS REMAIN IN THE CONTEST, WHILE THE LOSING TEAM IS ELIMINATED.
   C. THE FINALS WILL CONSIST OF TWO OUT OF THREE RACE WINNERS.



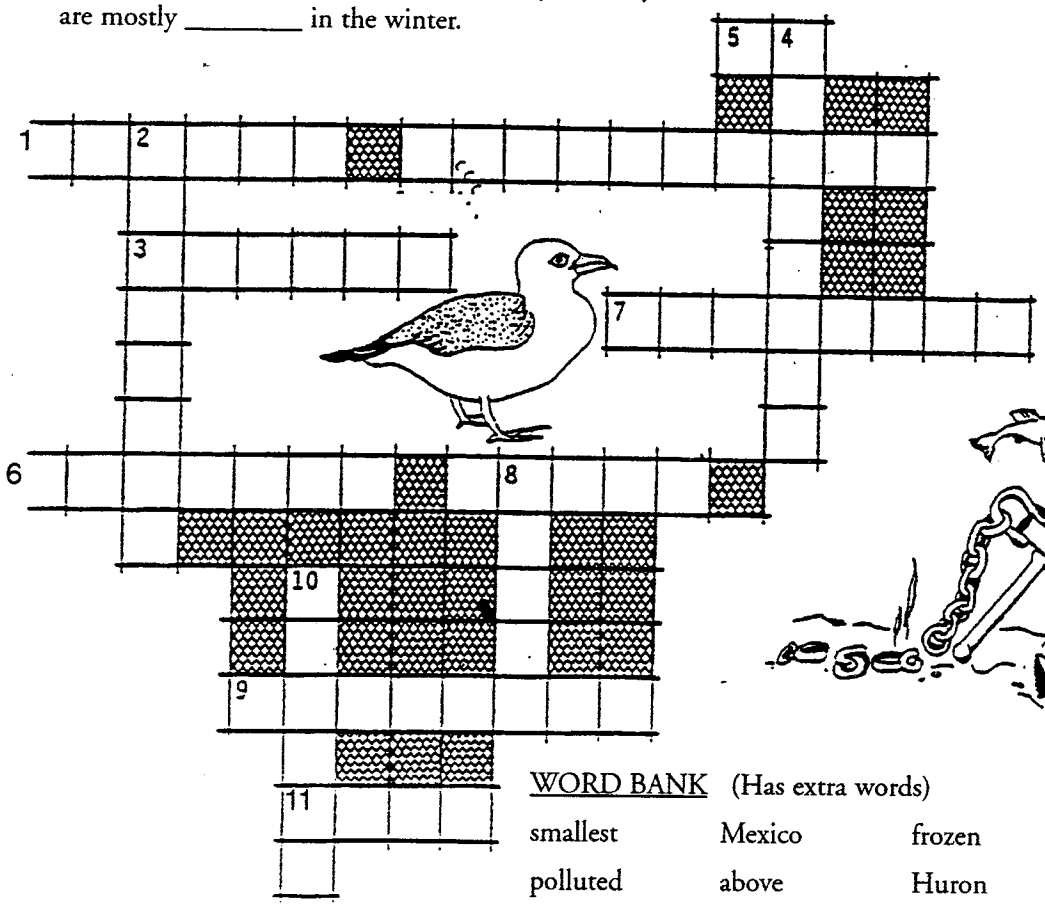
THE MIGHTY GREAT LAKES

ACROSS

1. It is often dangerous for boats on the Great Lakes because of storms. In 1975, the freighter _____ _____ , sank in Lake Superior
3. The Great Lakes form part of the boundary between _____ and the United States.
5. Lake Michigan is the only one of the Great Lakes which is completely in the _____. (Use the abbreviation)
6. Lake Erie is much higher than Lake Ontario. Due to this difference, water goes over the famous _____ _____, which are between the two lakes.
7. The largest body of fresh water in the world is Lake _____.
9. The famous tourist spot, Mackinac Island, is in the *northern or southern* part of Lake Huron?
11. At 1,333 feet, Lake Superior is the deepest. At 210 feet at its deepest point, Lake _____ is the shallowest.

DOWN

2. Lake _____ is on the west coast of our Lower Peninsula, while Lake Huron is on the east coast of the Lower Peninsula.
4. Lake Ontario is the farthest Great Lake from Michigan, and it is the _____.
8. The Soo Locks were built because Lake Superior is _____ the level of Lake Huron.
10. The Great Lakes are not used by boats all year. They are mostly _____ in the winter.



What's this anchor doing here? That's the last time I'll let your mother decorate our home!

WORD BANK (Has extra words)

smallest	Mexico	frozen	Michigan
polluted	above	Huron	smelliest
northern	Canada	Erie	Superior
U.S.	R.R.	Niagara Falls	
Edmund Fitzgerald		Queen Elizabeth	

DRY DOCK DAY: SOCIAL STUDIES WORK PACKAGE

CLEAN FRESH WATER - A SCARCE COMMODITY

More than 70% of the earth's surface is covered by water. But of all that water, about 97% is salty ocean water. Of the remaining three percent of earth's water, more than two thirds is frozen in glaciers and polar ice sheets. That leaves less than one percent of the water on earth for our use; and most of that water is ground water, which is water stored underground in porous rock and loose sand and gravel. It is this last water that we will try to find as a class on one of our field trips.

DICTIONARY WORK: Look-up and give a definition for the following:

1. Aquifer
2. Bay
3. River Mouth
4. Peninsula
5. Rapids

AQUAFACT! Water transpires, or passes as a vapor, from leaves into the air. About 4,000 gallons of water transpires from a one acre corn field in a day.

AQUAFACT! Fifty percent of the people in the United States use ground water for drinking water. Ground water makes up 95% of the fresh water resources in the United States.

SOME MICHIGAN WATERS THAT ARE TOURIST ATTRACTIONS (find them on a Michigan Map; On a blank Michigan Map draw a symbol where they are located)

1. Lake of the Clouds
2. Tahaquemon River Falls
3. Glen Lake, Sleeping Bear Dunes
4. Kitch-iti-ki-pi
5. St. Mary's River Rapids

BRIDGES CROSS SOME OF MICHIGAN'S FAMOUS FRESH WATERS (Name the water that these famous bridges of Michigan cross over)

1. Blue Water
2. Ambassador
3. Mackinaw
4. International
5. Zilwalkee
6. Houghton-Hancock

THE GREAT LAKES WATERWAY

The Great Lakes are great not only in size, but in importance. They supply water for nearby towns and cities, fish for industry and sport fishing, beautiful waters for boating, and beaches for swimming. In addition to all this, they make up a valuable water highway where resources such as iron ore can be

shipped to factories all over the world.

Make a drawing of a profile or side view of the Great Lakes. If you look closely you will see that all the lakes are not on the same level. They are like bowls with water spilling into each other. The water in Lake Ontario spills into the St. Lawrence River and flows eastward to the Atlantic Ocean.

Trace a shipping route from Chicago to Lisbon, Portugal by naming all the waters a ship would have to take to complete the voyage.

2) What are the different waters used from Duluth to Lisbon?

PROFILE DRAWING OF THE GREAT LAKES

All the Great Lakes connect naturally with each other by rivers, straits, or smaller lakes. Ships could not always pass through some of these connectors. In the 1850's a canal and locks were built on the St. Mary's River between Lake Huron and Lake Superior.

The locks, like a giant stairway, lower ships from the higher level of Lake Superior to the lower level of Lakes Huron and Michigan. They also raise the level of ships traveling into Lake Superior.

The Great Lakes highway became even more important in 1959 when a series of canals, locks, and dams were completed on the St. Lawrence River. This system, known as the St. Lawrence Seaway, made it possible for ships to travel from the Atlantic Ocean all the way to the western end of Lake Superior, about 2,300 miles.

The text and Profile of the Great Lakes will help you answer the following questions:

1. Which is the deepest of the Great Lakes? _____
2. Which Great Lake is the shallowest? _____
3. What connects Lake Michigan and Lake Huron? _____
4. What small lake lies between Lake Huron and Lake Erie? _____
5. What important canal and lock system between Lake Superior and Lake Huron was opened in 1855?

_____

6. What is the name of the system of canals, locks, and dams which connects the Great Lakes Waterway with the Atlantic Ocean? _____

MAJOR INDUSTRIES AND ECONOMICS BECAUSE OF FRESH WATER (rivers and Great Lakes)

a. Commercial Fishing
b. Recreational Fishing
c. Lumbering
d. Orchard Crops
e. Fur Trade Highways
f. Tourist Attractions

MAPPING MICHIGAN'S ECONOMY

Water Facts and Expressions

(Language Arts)

Fishy Fact Wall and Game

1. Collect facts about your lake or a lake you are assigned.
2. Place this proofread fact on a fish. See Template.
3. Decorate your fish.
4. Each student must produce two completed fish.
5. Each fish must be tagged with a number. The teacher should assign and attach the number.
6. Place fish in the correct lake on the wall in the hallway.

GAME

1. **Do all the above.**
2. **Each teacher will create 2 fish containing incorrect or "fishy" information about their lake.**
3. **They will decorate the fish and place them on the wall.**
4. **All fish will be tagged with a number.**
5. **Students are to locate the 'fishy' facts. The students who locate all the 'fishy' facts will be recognized.**
6. **Recognition may also be given to students with creative fish.**

Fishy Facts

Student name _____

Lake Name _____

Read the facts about the lakes on the wall. Find the two (2) fish which have incorrect facts written on them. There are two fish for each of the lakes.

List the letter and the number of the fishy fact fish below. Return this sheet to your lake leader.

Lake St. Clair _____ _____

Lake Huron _____ _____

Lake Superior _____ _____

Lake Erie _____ _____

Lake Michigan _____ _____

Lake Ontario _____ _____